NAVAIR 17-20AW-147L

TECHNICAL MANUAL

INSTRUMENT CALIBRATION PROCEDURE

AW-147L

SPECTRUM ANALYZER DISPLAY SECTION

HEWLETT PACKARD 141T

AW-147L

PUBLISHED BY DIRECTION OF COMMANDER NAVAL AIR SYSTEMS COMMAND

1 AUGUST 1978

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE

On a changed page, the portion of the text affected by the latest change is indicated by a vertical line in the outer margin of the page.

Page No.	Change No. *	Change Date	Page No.	Change No. *	Change Date
Title	0				
A	0				
i	0				
1 to 15	0				
16(blank)	0				
17	0				

*Zero in this column indicates an original page.

TABLE OF CONTENTS

Section		Page
1	Introduction and Description	1
2	Equipment Requirements	2
3	Preliminary Operations	4
4	Calibration Process	6
4.1	Line Voltage Regulation	6
4.2	Intensity Limit and Geometry	7
4.3	Variable Persistence	7
4.4	Fast Writing Speed	8
4.5	Fast Store Time	8
4.6	Standard Writing Speed	8
4.7	Standard Store Time	9
4.8	TI Shutdown	9
5	Adjustment Process	10
5.1	Power Supplies	10
5.2	Intensity and Geometry	11
5.3	Variable Persistence	12
5.4	Standard Mode	12
	Navy Calibration Checklist	17

ILLUSTRATIONS

Figure		Page
1	CRT Display	14
2	Adjustment Locations (Bottom view)	15

TABLES

Table		Page
1	Calibration Description	1
2	Power Supply Adjustments	10

SECTION 1

INTRODUCTION AND DESCRIPTION

1.1 This procedure describes the calibration and adjustment of the Hewlett-Packard Model 141T Spectrum Analyzer Display Section referred to herein as the TI (Test Instrument).

1.2 This procedure was prepared by Hughes Aircraft for use by Phase F-14 activities. All comments should be forwarded to the Metrology Engineering Center, Naval Plant Representative Office, Pomona, California. Use of the Calibration Problem Report cards provided with this procedure is recommended.

Table 1. Calibration Description

TI Characteristics	Performance Specification	Test Method
Line voltage regulation (4.1)	Line input voltage: 105 to 125 V dc Display variation: Width: 0.1 div. Amplitude: 0.2 div.	Display is observed as line voltage is varied.
Intensity Limit and Geometry (4.2)	Spot visible with INTENSITY control at 11 o'clock	TI CRT observed
	No horizontal or vertical distortion	TI CRT observed with markers displayed
Variable Persistence (4.3)	Persistence: 1 minute or more	TI CRT observed
Fast Writing Speed (4.4)	Persistence: 15 seconds or more	TI CRT observed
Fast Store Time (4.5)	Persistence: 15 minutes or more	TI CRT observed
Standard Writing Speed (4.6)	Persistence: 1 minute or more	TI CRT observed
Standard Store Time (4.7)	Persistence: 2 hours or more	TI CRT observed

SECTION 2

EQUIPMENT REQUIREMENTS

NOTE

Minimum use specifications are the principal parameters required for performance of the calibration, and are included to assist in the selection of alternate equipment, which may be used at the discretion of the using laboratory. Satisfactory performance of alternate items shall be verified prior to use. All applicable equipment must bear evidence of current calibration.

Item	Minimum Use Specifications	Recommended Test Equipment[1]	Use[2]
2.1 Autotransformer	Input voltage: 105 to 125V, 60 Hz, single phase Output voltage: adjustable from 105 to 125 V at 5 amps, metered output	General Radio Model W10MT3A Autotransformer	C, A
2.2 RF Section	Compatible with TI	Hewlett Packard Model 8553B Spectrum Analyzer RF Section	C, A
2.3 IF Section	Compatible with TI	Hewlett Packard Model 8552B Spectrum Analyzer IF Section	C, A

(Continued on page 3)

[1]The instruments utilized in this procedure were selected from those known to be available at Department of Defense facilities, and the listing by make or model number carries no implication of preference, recommendation, or approval by the Department of Defense for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance in the procedure.

[2]The instruments utilized in this procedure that are required for Calibration are identified with a "C". The instruments utilized for Adjustments are identified with an "A" and if required for both Calibration and Adjustment the identification is "C, A".

Item	Minimum Use Specifications	Recommended Test Equipment[1]	Use[2]
2.4 Cable	18 inch, RG-58C/U, BNC male to BNC male	Pomona Model BNC-C-18 Cable Assembly	C, A
2.5 Test Lead	8 inch, Minigator clip grabber, both ends	Pomona Model 3781-8 Test Lead	C, A
2.6 Generator	Output: 10 MHz markers	Hewlett Packard Model 8406A Frequency Comb Generator	C, A
2.7 Cable	36 inch, RG-58C/U, BNC male to BNC male	Pomona Model BNC-C-36 Cable Assembly	C, A
2.8 Multimeter	Range: -100 to 250 V dc Acc: ±0.1%	Fluke Model 8350A Digital Multimeter	A
2.9 Probe	48 inch, shielded test probe to double banana plug	Pomona Model 1569-C-48 Test Probe	A
2.10 Test Probe	Ratio: 1000:1 Acc: ±0.3% Minimum input voltage: -2500 V dc	Fluke Model 80K-40 High Voltage Probe	A
2.11 Adapter	BNC female to N male	Amphenol Model UG-201A/U Adapter	C, A

SECTION 3

PRELIMINARY OPERATIONS

3.1 Verify that all power switches are off and connect all applicable equipment, except the TI, to the appropriate power source.

3.2 Before power switches are turned on, set all auxiliary equipment controls so that dangerous voltages will not be present on output terminals and to avoid damage to the equipment.

3.3 Energize equipment listed in Section 2 and allow sufficient time for equipment to warm-up and stabilize.

3.4 Adjust autotransformer (2.1) output voltage control for minimum.

NOTE

RF section (2.2) and IF section (2.3) must be mechanically fitted together, electrically connected, and then inserted into TI.

3.5 Install RF section and IF section in TI.

3.6 Connect TI power cord to autotransformer and adjust autotransformer voltage control for meter indication of 115 volts.

3.7 Position TI controls as follows:

INTENSITY control	fully ccw
PERSISTENCE control	MIN (ccw)
WRITING SPEED STD. switch	press in

3.8 Position RF section controls as follows:

RANGE MHz switch	0-110
FREQUENCY control	30 MHz
BANDWIDTH switch	300 kHz
ZERO/PER DIVISION/0-100 MHz switch	PER DIVISION
SCAN WIDTH switch	1 MHz
INPUT ATTENUATION switch	10 dB

3.9 Position IF section controls as follows:

SCAN TIME PER DIVISION switch	5 MILLISECONDS
2 dB LOG/10 dB LOG/LINEAR switch	LINEAR
LINEAR SENSITIVITY switch	fully ccw
VIDEO FILTER switch	OFF
SCAN MODE switch	INT
SCAN TRIGGER switch	AUTO

3.10 Set TI LINE switch to ON. Power lamp lights. Allow 15 minutes warm-up.

NOTE

TI BEAM FINDER switch has no function when TI is utilized as a spectrum analyzer display section.

CAUTION

Trace blooming indicates excessive intensity that can damage TI CRT.

3.11 Set IF section SCAN TIME PER DIVISION switch to 10 SECONDS.

3.12 Adjust TI INTENSITY, FOCUS, and ASTIG controls for smallest, round dot.

3.13 Set IF section SCAN TIME PER DIVISION switch to 2 MILLISECONDS.

3.14 Adjust TI TRACE ALIGN adjustment for CRT display of trace parallel to horizontal graticule line.

SECTION 4

CALIBRATION PROCESS

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met, before proceeding.

4.1 LINE VOLTAGE REGULATION

CAUTION

Damage to RF section will result if TI CAL 1V or CAL 10V connectors are connected to RF section RF INPUT connector.

4.1.1 Connect IF section CAL OUTPUT connector to RF section RF INPUT connector with cable (2.4).

4.1.2 Adjust RF section controls for TI CRT display of 30 MHz signal at TI CRT center vertical graticule line.

4.1.3 Adjust RF section and IF section controls for TI CRT display as shown in Figure 1. Note display width at LOG dB -40 graticule line.

4.1.4 Adjust autotransformer voltage control for meter indication of 105 volts.

4.1.5 TI CRT display amplitude is between 6.8 and 7.2 divisions and display width changes less than 0.1 division from width noted in step 4.1.3. If not, refer to Section 5.1 for adjustments.

4.1.6 Adjust autotransformer voltage control for meter indication of 125 volts.

4.1.7 TI CRT display amplitude is between 6.8 and 7.2 divisions and display width changes less than 0.1 divisions from width noted in step 4.1.3. If not, refer to Section 5.1 for adjustments.

4.1.8 Adjust autotransformer voltage control for meter indication of 115 volts.

4.1.9 Disconnect cable (2.4).

4.2 INTENSITY LIMIT AND GEOMETRY

4.2.1 Set TI LINE switch to off (down).

4.2.2 Remove RF section and IF section from TI.

4.2.3 Remove TI top cover.

4.2.4 Short together pins 1 and 2 of TI J2 (top RF connector) with test lead (2.5).

4.2.5 Set TI LINE switch to ON. Power lamp lights.

4.2.6 Turn TI INTENSITY control to 11 o'clock.

4.2.7 TI CRT displays spot that is just visible. If not, refer to Section 5.2, steps 5.2.1 and 5.2.2 for adjustments.

4.2.8 Set TI LINE switch to off (down).

4.2.9 Remove test lead.

4.2.10 Install RF section and IF section in TI.

4.2.11 Set TI LINE switch to ON. Power lamp lights.

4.2.12 Connect generator (2.6) to RF section RF INPUT connector with cable (2.7) and adapter (2.11).

4.2.13 Set RF section SCAN WIDTH switch to 10 MHz and INPUT ATTENUATION switch to 20 dB.

4.2.14 Adjust generator output controls for 10 MHz markers.

4.2.15 Adjust RF section and IF section controls for TI CRT display of one marker per division and full scale deflection.

4.2.16 TI CRT displays markers with no bowing of vertical lines or horizontal distortion. If not, refer to Section 5.2, steps 5.2.3 and 5.2.4, for adjustments.

4.2.17 Disconnect equipment.

4.3 VARIABLE PERSISTENCE

4.3.1 Set IF section SCAN TIME switch to 2 SECONDS.

4.3.2 Adjust TI INTENSITY control for normal display intensity.

4.3.3 Turn TI PERSISTENCE control fully cw.

4.3.4 After one full scan turn TI INTENSITY control fully ccw.

4.3.5 TI CRT display remains visible for 1 minute or more. If not, refer to Section 5.3 for adjustments.

4.4 FAST WRITING SPEED

4.4.1 Set IF section SCAN TIME switch to .1 MILLISECONDS and SCAN MODE switch to SINGLE.

4.4.2 Press TI FAST switch to in.

4.4.3 Press and release TI ERASE switch.

4.4.4 Turn TI INTENSITY control slightly cw.

4.4.5 Press IF section SINGLE switch.

4.4.6 Repeat steps 4.4.3 thru 4.4.5 as necessary. TI CRT trace remains visible 15 seconds or more. If not, refer to Section 5.3 for adjustments.

4.5 FAST STORE TIME

4.5.1 Set TI STORE TIME control to MAX (fully cw).

4.5.2 Press and release TI ERASE switch.

4.5.3 Press IF section SINGLE switch.

4.5.4 Press TI STORE switch to in.

NOTE

Do not wait for this 15 minute test unless the user identifies storage as a problem.

4.5.6 TI CRT trace is visible. If not, refer to Section 5.3 for adjustments.

4.6 STANDARD WRITING SPEED

4.6.1 Press TI STD switch to in.

4.6.2 Press and release TI ERASE switch.

4.6.3 Turn TI INTENSITY control slightly cw.

4.6.4 Press IF section SINGLE switch.

4.6.5 Repeat steps 4.6.2 thru 4.6.4 as necessary. TI CRT trace remains visible for 1 minute or more. If not, refer to Section 5.4 for adjustments.

4.7 STANDARD STORE TIME

4.7.1 Press TI STD switch to in.

4.7.2 Set TI STORE TIME control to MAX (fully cw).

4.7.3 Press and release TI ERASE switch.

4.7.4 Press IF section SINGLE switch.

4.7.5 Press TI STORE switch to in.

NOTE

Do not wait for this 2 hour test, unless the user identifies storage as a problem.

4.7.6 After two hours, set TI STORE TIME control to MIN (fully ccw).

4.7.7 TI CRT trace is visible. If not, refer to Section 5.4 for adjustments.

4.7.8 Set TI INTENSITY control to MIN (fully ccw).

4.8 TI SHUTDOWN

4.8.1 De-energize and disconnect equipment.

4.8.2 Re-install protective covers on TI.

4.8.3 Complete calibration decal and affix to TI.

SECTION 5

ADJUSTMENT PROCESS

NOTE

The adjustment steps in this section of the procedure are included only to correct for an out-of-tolerance condition noted during the calibration. Remove and replace TI protective covers as required.

5.1 POWER SUPPLIES

CAUTION

TI adjustments are near voltage points. Use non-metallic tool for adjustments.

5.1.1 Connect multimeter (2.8) to TI wire colors listed in Table 2 and ground with probe (2.9). For each connection perform the following:

5.1.1.1 Adjust TI adjustment listed for multimeter indication of nominal voltage.

5.1.1.2 Adjust autotransformer voltage control for meter indication of 105 volts.

5.1.1.3 Multimeter indicates within specified limits.

5.1.1.4 Adjust autotransformer voltage control for meter indication of 125 volts.

5.1.1.5 Multimeter indicates within specified limits.

5.1.1.6 Adjust autotransformer voltage control for meter indication of 115 volts.

Table 2. Power Supply Adjustments

TI		Multimeter Indication (V dc)	TI Adjustment (Figure 2)
Test Point (Wire Color)	Nominal (V dc)		
White/Red	100.0	99.7 to 100.3	A2R11B
Violet	-100.0	-99.0 to -101.0	A2R11C
Red	248.0	245.5 to 250.5	A2R11A
White/Violet	-12.6	-12.47 to -12.73	A2R47A

5.1.2 Disconnect probe.

5.1.3 Connect multimeter to TI violet wire test point and ground with test probe (2.10).

5.1.4 Record multimeter indication.

5.1.5 Multiply indication recorded in step 5.1.4 by 23.50 and record.

WARNING

Voltages hazardous to life are present during the following steps. Use extreme care when making connections or taking measurements inside TI.

5.1.6 Connect multimeter to TI -2350 V test point (figure 2) and ground with test probe (2.10).

5.1.7 Adjust TI A2R63 adjustment (figure 2) for multimeter indication recorded in step 5.1.5.

5.1.8 Adjust autotransformer voltage control for meter indication of 105 volts.

5.1.9 Multimeter indicates within 1% of value recorded in step 5.1.5.

5.1.10 Adjust autotransformer voltage control for meter indication of 125 volts.

5.1.11 Multimeter indicates within 1% of value recorded in step 5.1.5.

5.1.12 Adjust autotransformer voltage control for meter indication of 115 volts.

5.1.13 Disconnect equipment.

5.1.14 Continue procedure starting with step 4.1.3.

5.2 INTENSITY AND GEOMETRY

5.2.1 Adjust TI A2R65 adjustment (figure 2) until TI CRT display dot is just visible.

5.2.2 Continue procedure starting with step 4.2.8.

5.2.3 Adjust TI A2R72 adjustment (figure 2) for TI CRT display of markers with best compromise between vertical and horizontal distortion.

5.2.4 Continue procedure starting with step 4.2.17.

5.3 VARIABLE PERSISTANCE

5.3.1 Press TI FAST switch to in.

5.3.2 Turn TI INTENSITY and PERSISTENCE controls fully ccw.

5.3.3 Set IF section SCAN MODE switch to SINGLE.

5.3.4 Adjust TI A5R14A adjustment (figure 2) fully ccw.

5.3.5 Adjust TI A5R14B adjustment (figure 2) for visible TI CRT flood gun illumination.

5.3.6 Adjust TI A5R14C adjustment (figure 2) for brightest, most uniform TI CRT illumination.

5.3.7 Adjust TI A5R14B adjustment (figure 2) for full TI CRT illumination.

5.3.8 Turn TI PERSISTENCE control fully cw.

5.3.9 Press and release TI ERASE switch.

NOTE

Press and release TI ERASE switch for each change of adjustment in steps 5.3.10 and 5.3.11.

5.3.10 Adjust TI A5R14A (figure 2) slowly cw for good compromise between CRT non-illuminated display and saturated brightness display as ERASE switch is pressed.

5.3.11 Adjust TI A5R14B adjustment (figure 2) in small increments. After each increment adjust TI A5R14A adjustment for CRT display uniform fogging.

5.3.12 Continue procedure starting with step 4.3.1.

5.4 STANDARD MODE

5.4.1 Turn TI INTENSITY and PERSISTENCE controls fully ccw.

5.4.2 Adjust TI A5R10A adjustment (figure 2) fully ccw.

5.4.3 Press TI STD switch to in.

5.4.4 Set IF section SCAN MODE switch to SINGLE.

5.4.5 Press TI ERASE switch for 1 second and release.

NOTE

Collimator dimples (figure 1) may protrude 3 mm from aluminum ring but must not extend into graticule area.

5.4.6 Adjust TI A5R10B adjustment (figure 2) fully ccw, then slowly cw for CRT screen illuminated to within 1 mm of aluminum ring (figure 1).

5.4.7 Turn TI PERSISTENCE control fully cw (MAX).

5.4.8 Turn TI A5R10A adjustment (figure 2) cw in 10° increments until TI CRT does not fully erase when TI ERASE switch is pressed.

5.4.9 Slowly turn TI A5R10A adjustment (figure 2) ccw until TI CRT erases completely when TI ERASE switch is pressed.

5.4.10 Repeat Performance Check paragraphs 4.6 and 4.7.

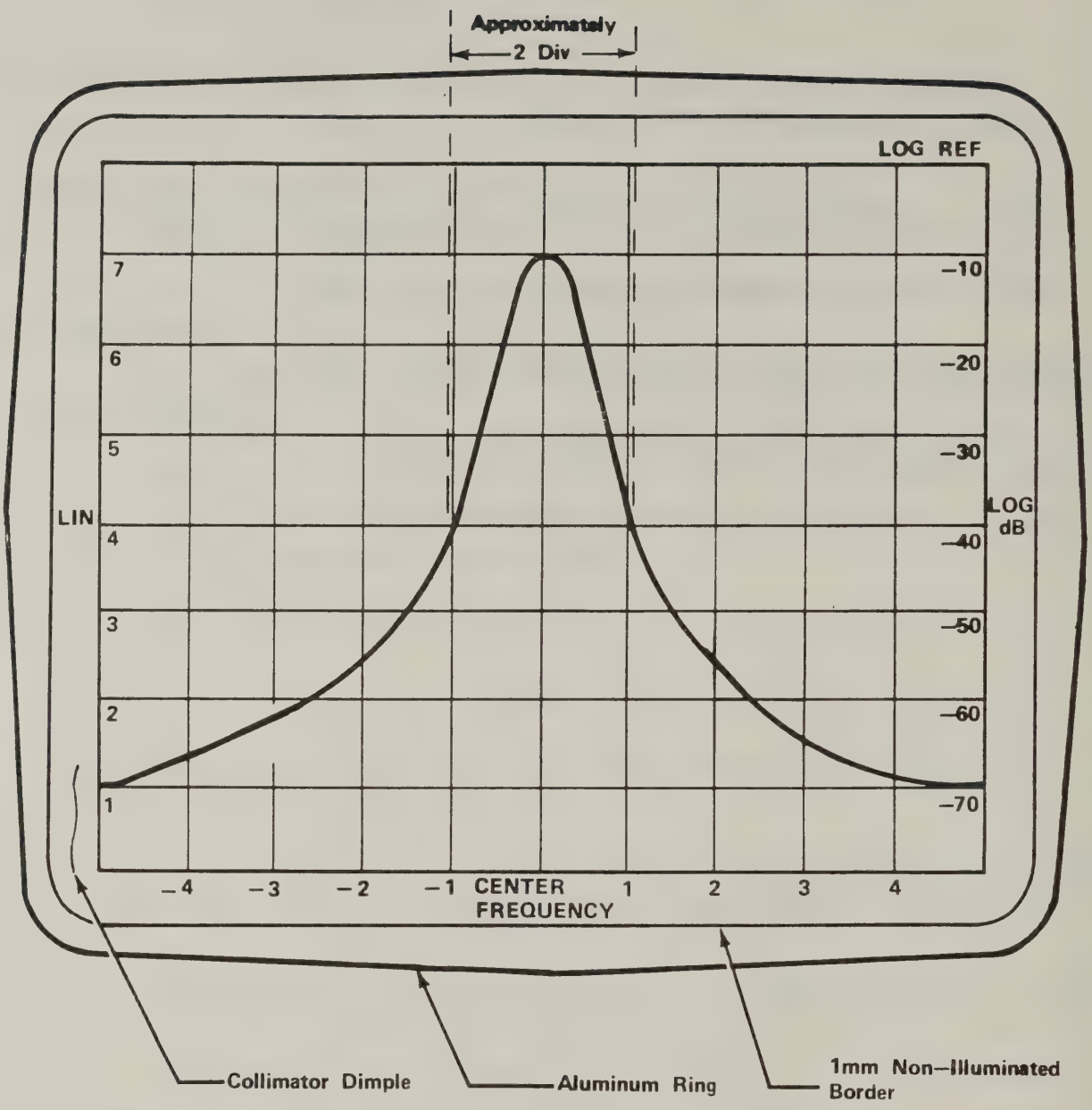


Figure 1. CRT Display

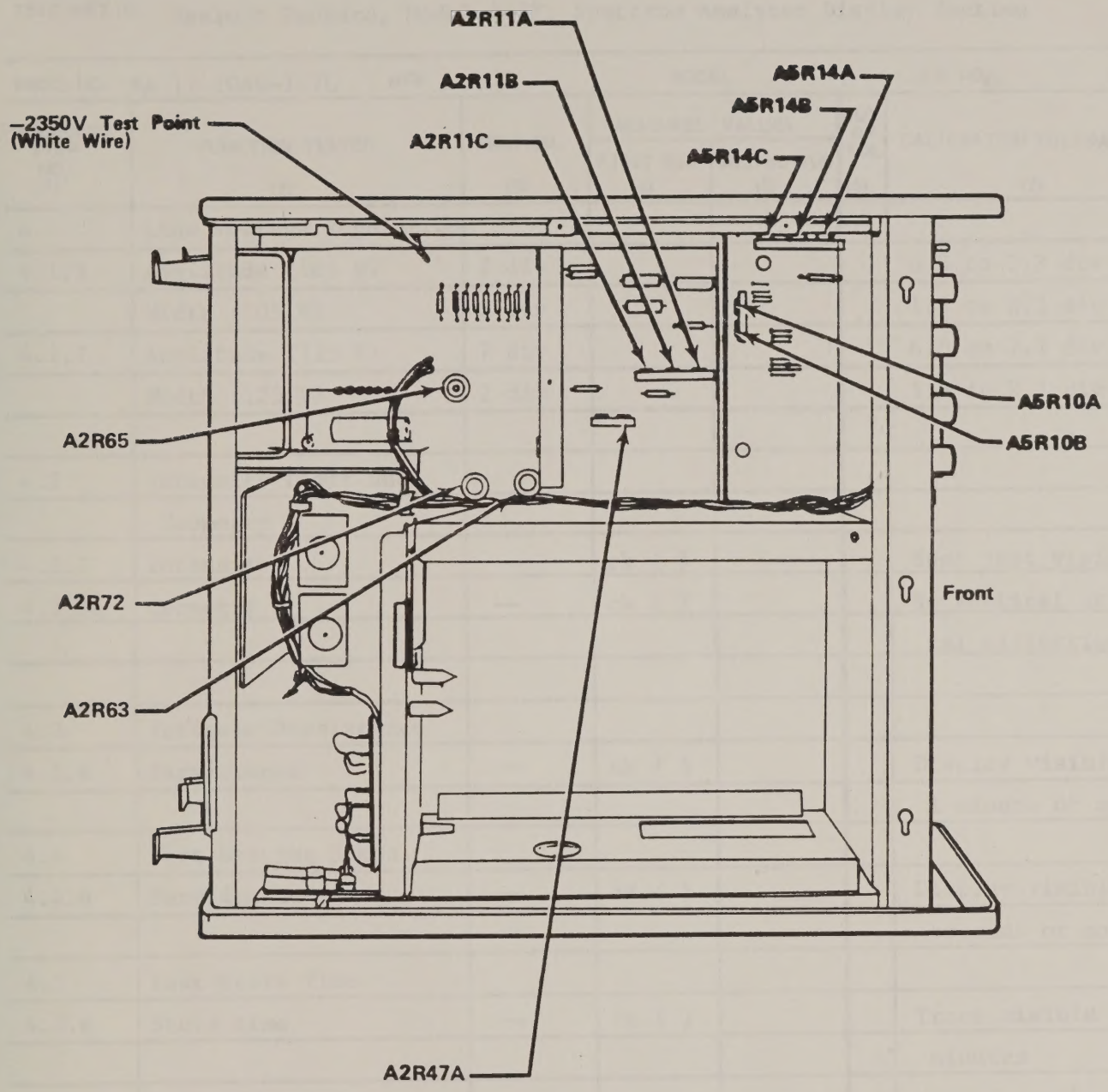
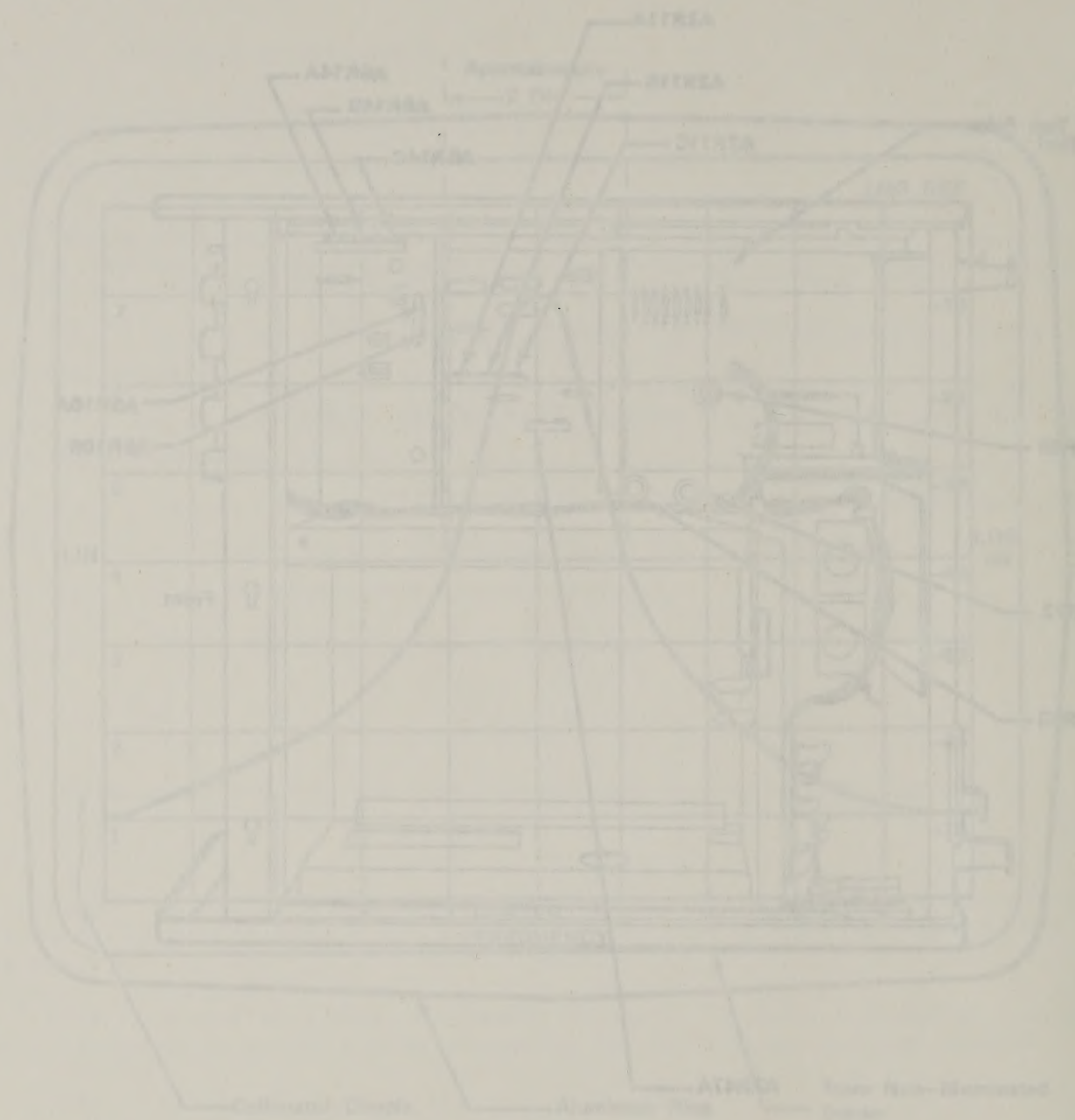


Figure 2. Adjustment Locations (Bottom View)



CALIBRATION CHECKLIST

TEST INST (S): Hewlett Packard, Model 141T, Spectrum Analyzer Display Section

PROC. NO. NA 17-20AW-147L MFR MODEL SER. NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	CALIBRATION TOLERANCES (7)
4.1	Line Voltage Regulation					
4.1.5	Amplitude (105 V)	7 div				6.8 to 7.2 div
	Width (105 V)	2 div				1.9 to 2.1 div
4.1.7	Amplitude (125 V)	7 div				6.8 to 7.2 div
	Width (125 V)	2 div				1.9 to 2.1 div
4.2	Intensity Limit and					
	Geometry					
4.2.7	Intensity	--	ck ( )			Spot just visible
4.2.16	Geometry	--	ck ( )			No vertical or horizon-
						tal distortion
4.3	Variable Persistence					
4.3.4	Persistence	--	ck ( )			Display visible for
						1 minute or more
4.4	Fast Writing Speed					
4.4.6	Persistence	--	ck ( )			Display visible for 15
						seconds or more
4.5	Fast Store Time					
4.5.6	Store time	--	ck ( )			Trace visible after 15
						minutes
4.6	Standard Writing Speed					
4.6.5	Persistence	--	ck ( )			Trace visible for 1
						minute or more
4.7	Standard Store Time					
4.7.7	Store time	--	ck ( )			Trace visible after 2
						hours